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(54) Title: SELECTING A NETWORK IN A CELLULAR COMMUNICATIONS SYSTEM		
(57) Abstract		
<p>A method of, and apparatus for, selecting a network in a cellular communications system, comprising a user transmitting a resource query identifying a service and a service provider to different networks, the networks communicating with the service provider to acquire service provider resource functions, the networks determining respective network resource functions, each network calculating a respective overall resource function, the networks transmitting their respective overall resource function to the user, and the user selecting whichever network has transmitted the optimum overall resource function. One applicable resource is cost. The resource functions incorporate different arrangements with different further communications elements, so providing best overall costs to the user. Also described is a corresponding network in a cellular communications system, and a user terminal for selecting a network in a cellular communications system.</p>		

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SELECTING A NETWORK IN A CELLULAR COMMUNICATIONS SYSTEMField of the Invention

- 5 The present invention relates to a method of, and apparatus for, selecting a network in a cellular communications system. The present invention also relates to a network in a cellular communications system. The present invention also relates to a user terminal for selecting a network in a cellular communications system. The present invention is applicable to, but not limited to, the Universal Mobile Telecommunication System
10 (UMTS) currently under standardisation.

Background of the Invention

- 15 One type of communications system is a cellular communications system. In a cellular communications system, the area over which service is provided is divided into a number of smaller areas called cells. Typically each cell is served from a base transceiver station (BTS) which has a corresponding antenna or antennas for transmission to and reception from a user station, normally a mobile station. Presently established cellular radio communications systems include GSM systems (Global
20 System for Mobile Communications).

In the same geographical area, a plurality of different commercial networks provide to a user alternative choices of access to what can be considered in general terms an overall cellular communications systems. Depending on the commercial and technical
25 arrangements, the different networks may share hardware or may each have separate hardware such as BTSs.

- 30 In known cellular systems, the means by which a user selects a network is pre-determined to select a particular network, provided the radio signal offered by that network meets a certain minimum standard. Only if that signal fails to meet that standard, are other networks considered for selection. Even when roaming such that the users primary network choice is not available, networks are chosen merely on signal strength or some other simple criteria basis.
- 35 The Universal Mobile Telecommunication System (UMTS) currently under standardisation is intended to provide a harmonised standard under which cellular radio communications networks and systems will provide enhanced levels of interfacing and

compatibility with other types of communications systems, which in addition to speech and data services, will further include extensive provision for multi-media communications. It is also expected that within the framework of developments such as UMTS or the like, cellular radio communication systems will play an increasing role in 5 information highways such as the internet.

Generally speaking, the above described increase in range of communications services to be provided by cellular radio communications systems along the lines of UMTS creates a broad range of new engineering problems and challenges. Indeed, one of the 10 challenges faced is to envisage what new opportunities arise to provide users with additional flexibility of choice in the light of such a combination.

Summary of the Invention

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In the light of the above, the present inventors have envisaged that it will be desirable to optimise the basis on which a user selects a network in a communications system. In particular, the present inventors have envisaged that known ways of selecting a network in a cellular communications system will be undesirable for the case, in systems such as 20 UMTS, where the network is to be used merely as one part of an overall communications route, which overall communications route will comprise also a further communications element such as a landline telecommunications link, and moreover where the communications link is to be used to convey a service from a separate service provider. In particular, the present inventors have envisaged that overall considerations 25 involving the cellular network's relationships with the further communication link and the service provider might be more significant to the benefit to the user when choosing the cellular network part of the overall link.

The present invention implements means for an improved network selection basis to be 30 provided to users that takes advantage of the characteristics described above and envisaged by the present inventors.

According to one aspect of the present invention, there is provided a method of selecting a network in a cellular communications system, as claimed in claim 1.

35

According to another aspect of the present invention, there is provided an apparatus for selecting a network in a cellular communications system, as claimed in claim 5.

According to another aspect of the present invention, there is provided a network in a
5 cellular communications system, as claimed in claim 9.

According to another aspect of the present invention, there is provided a user terminal for selecting a network in a cellular communications system, as claimed in claim 13.

10 Further aspects of the invention are as claimed in the dependent claims.

- The present invention advantageously enables a user to select the network according to the total ultimate level of a resource that will result in the choice of that network. Thus, when the resource under consideration is financial cost, the user will be able to select
15 that network which will provide the lowest overall cost of the service being provided from the service provider to the user via the overall communications route. This is advantageous over consideration of just the direct costs of the network per se. Similar advantages occur for other resource types, for example power required.
- 20 A preferred version of the present invention enables the user to vary which type of resource is to be considered. So for example, in the case where the user can vary between cost and power, the user can decide to usually select a network based on cost, but when his power supply is low can instead decide to select according to power usage.
- 25 Additional specific advantages are apparent from the following description and figures.

Brief Description of the Drawings

30 Fig. 1 is a schematic illustration of an embodiment of the present invention.

Fig. 2 is a schematic illustration of a user station including an external device according to an embodiment of the present invention.

Description of an Embodiment of the Invention

- One particular embodiment of the invention is now described by way of example only.
- Fig. 1 shows, in the form of a schematic illustration, an arrangement including a user terminal 110. The user terminal is the apparatus by which a user interfaces with a plurality of cellular radio networks within a cellular radio communications system. In the present embodiment the user terminal 110 is a mobile station, and is in the form of a mobile telephone. The user terminal achieves a communications link with the networks via respective radio links.
- In the present embodiment the plurality of networks is made up of only two networks, namely a first network 120 and a second network 130. The radio link between user terminal 112 and first network 120 is shown as item 112 in Fig. 1, and the radio link between user terminal 112 and second network 130 is shown as item 114 in Fig. 1. In the present embodiment the first network and the second network are each made up of separate hardware such as base station systems, switches, radio transceivers and so on. Also they are separate in a commercial sense. They are however understood in the present context to represent two parts of an overall cellular communications system in the sense that the geographical areas they serve overlap, and the user, via his user terminal, is able to access and use both networks. It is to be appreciated that in other embodiments the different networks could share some or all of their hardware, but constitute nevertheless different networks by virtue of being managed by different commercial entities on a time division basis or with respect to access to different radio channels and so on, and these networks may themselves be hiring such air-time or channels from different commercial entities using the relevant hardware.
- Fig. 1 further shows a service provider 140. In the present exemplary embodiment service provider 140 provides a service consisting of arranging a commercially competitive overall communications route for the user to make a call to a telephone number selected by the user. In the present embodiment let us consider that the call is an international call. Moreover, the call in the present example requires multi-media facilities in the sense of live video communication plus data transfer capability. The service provider will set-up the call in the sense of arranging it and hiring as appropriate the communication links forming the overall communications route. The overall communications route for the call of the present example will comprise the selected

- cellular network plus a further communications element. Fig . 1 shows two such further communications elements, namely a first further communications element 150 and a second further communications element 160. First network 120 is coupled via a communications link 122 to the first further communications element 150 and via
- 5 communications link 124 to the second further communications element 160. Second network 130 is coupled via a communications link 134 to the first further communications element 150 and via communications link 132 to the second further communications element 160. In the present embodiment the further communications elements 150 and 160 consist of alternative international telecommunications link to the
- 10 country the present call is to be made to. In the present embodiment further links may be required thereafter depending on the details of the number called, and in the case of the first further communications element 150 these would be connected onwards via communications link 152, and in the case of further communications element 160, onwards via communications link 162. Thus, if ultimately first network 120 was selected
- 15 and the further communications element to be employed was the first further communications element 150, then the communications route would consist of radio link 112, first network 120, communications link 122, first further communications element 150, and onwards via communications link 152.
- 20 Service provider 140 is coupled furthermore as follows - to first network 120 by communications link 126, to second network 130 by communications link 136, to first further communications element 150 communications link 142, and to second further communications element 160 by communications link 144. Other possibilities exist, for example service provider 140 could be connected to the networks but not to the further communications elements.

The method of the present exemplary embodiment includes the step of the user transmitting a resource query to the networks, the resource query identifying the service and the service provider. In the present embodiment the resource query is sent from user terminal 112 to the two networks 120 and 130 by radio links 112 and 114 respectively.

30 The resource query identifies the service, i.e. an international call to a given number, the call requiring multi-media facilities in the sense of live video communication plus data transfer capability. Also, the user identifies the service provider, in this case service provider 140, who represents a supplier of international calls chosen by the user. The

35 resource query further specifies the type of resource the user is concerned about. In the

present embodiment, the resource the user is concerned about and hence specifies is the cost of the call. In the present embodiment the resource query is sent on an uplink access control channel of network 120 and similarly on an uplink access control channel of network 130. The initial choice of which networks are to be contacted can be

- 5 implemented in known fashion either manually controlled by the user or automatically controlled by default settings in the mobile telephone or a SIM card thereto coupled, further dependent on minimum radio signal levels being received.

The next step is that of the networks 120 and 130 communicating with service provider
10 140, via communications links 126 and 136 respectively, to acquire service provider resource functions applicable to delivery of said service with respect to the further communications elements 150 and 160 which represent the candidate further communications elements of the present embodiment, being for example the only two international telephone services to the country of the number called.

15 The networks in effect each request service provider 140 to inform them of any special pricing arrangements, such as discounts, appropriate tariffs, available capacity already paid for, and so on, pre that service provider 140 has in place with each of the further communications elements 150 and 152 respectively. This information, with respect to
20 service provider 140 and first further communications element 150 constitutes the service provider resource function with respect to further communications element 150, and similarly this information, with respect to service provider 140 and first further communications element 160 constitutes the service provider resource function with respect to further communications element 160. The exact content and form of this
25 information will depend on the particular circumstances, the type of service being provided, the resource being considered, the nature of the further communications elements, and so on. In the present embodiment, the information is in the form of pricing structure data arranged in a database format. The received data for first network 120 is collected and held in database 128 of that network, and the received data for second
30 network 130 is collected and held in database 138 of that network. The databases can be implemented in any appropriate form, including in the form of software or by a combination of software and hardware. In the present embodiment the databases are located in central operation centres of the respective networks, but they can also be located at any other appropriate location accessible to a networks, including being
35 distributed throughout a number of separate locations.

- A further step is that of the networks 120 and 130 determining a respective network resource function applicable to that network for delivery of services generally with respect to the further communications elements 150 and 160. It is expected that usually
- 5 the pricing structure information necessary for such determination relevant to general services transmitted from, for example, first network 120 via first further communications element 150 will already be known at first network 120, and this information will also be held in database 128. This is because normally cellular networks such as 120 and international telephone access such as first further communications
- 10 element 150 would be relatively stable and established such that this data was required all the time at the network. We shall assume this is the case in the present embodiment. However, it is noted that if this information was not held already, it could be gained by communication between the network and the further communications element via the appropriate communications link. In the present case, the pricing information already
- 15 held at the database is put in an appropriate form compatible with the form of the received service provider resource functions, thereby providing, for each network, a network resource function covering each of the candidate further communications elements.
- 20 Thus, in the present embodiment, each network at this stage of the procedure holds in its database respective service provider functions and respective network resource functions, in compatible formats for cross-referencing and optimising. In other words, each network, by using appropriate processing means and algorithms, can now analyse the different pricing structures, discounts etc. available, and in doing so include either or
- 25 both the benefits available from the network's relationship with the different further communications elements and the service provider's relationship with the different further communications elements, to arrive at the best overall cost that the network can offer the user if the user selects that network. This is implemented by the step of the networks calculating a respective overall resource function from the service provider
- 30 resource functions and the respective network resource function. In the present example, where the resource under consideration is cost, the respective overall resource function is simply in the form of the cheapest total cost for the call. However, in other situations, the overall resource function could be a more complicate function, involving more than one type of resource, or involving, say, costs that would vary at different times of the
- 35 day, and so on.

The next step is that of the networks transmitting their respective overall resource function to the user. In the case of first network 120, this is done via radio link 112, and in the case of second network 130, via radio link 114, on respective downlink control channels.

The received overall resource functions are stored at user terminal 110. Depending on the form of user terminal 110, they can be displayed to the user for consideration by the user, or processed automatically by processing means within the user terminal. In either case, the optimum overall resource function is determined, i.e. in the present example the different cost quotations are compared to determine which is the lowest cost. This can be determined by the user of the user terminal in the case when the values are displayed. Alternatively, the optimum overall resource function can be determined automatically by processing means within the user terminal.

The next step is that of the user selecting whichever network has transmitted the optimum overall resource function. This can also be carried out manually by the user, or in the case when the optimum overall resource function has been determined automatically in the user terminal, can be performed automatically also.

A second embodiment is implemented in corresponding fashion to the first embodiment except that the resource to be considered is power used by the user. Thus, instead of cost, the primary concern is power consumption. This situation could arise for example when the user terminal is a mobile telephone, for the purpose of minimising consumption of power from a battery of the mobile. In this case, different amounts of power could be used by the user depending on which further communications element was used, in the case where the service to be provided was one where different data rates or bandwidth could be supplied. Thus, the first further communications element 150 could have arrangements with service providers that offered different data rate, and the net effect would be to require more or less power usage by the user during the provided service. The present embodiment would be applicable where these different data rates and bandwidths were offered, in the same ways as the above described cost variations of the first embodiment, in ways according to respective arrangements between service providers and further communications elements and between service providers and cellular networks.

- In a third embodiment, implemented in corresponding fashion to the first and second embodiments, the user can vary which type of resource is to be considered. In the present case, the two resources are cost and power, as individually described above.
- 5 The user normally specifies cost as the resource to be considered, but is able to specify power instead, when he is concerned about low battery power. This choice could be made automatically by the user terminal by means of automatic monitoring of remaining battery power, battery power consumption levels and so on.
- 10 In the above embodiments, the user terminal 110 is a mobile station, in the form of a mobile telephone. In one version the mobile telephone can accept one or more smart cards such as Subscriber Identity Module (SIM) cards. The processing means, details of types of service, service provider details, network details, and resource choices and details, such as described above, can be located in the mobile telephone, in one or more 15 of the SIM cards, or distributed between the mobile telephone and one or more of the SIM cards. The user terminal can alternatively comprise a mobile telephone 210 comprising means for communicating over a communication link 220 with an external device 230, as shown in Fig. 2. The external device can in principle be any device not an integral part of the mobile station, for example a computer or an electronic organiser.
- 20 Alternatively, the external device can be a smart card, such as a SIM card. The communication link 320 is preferably a fixed cable connection with appropriate interfaces built into the mobile station and the external device, but other communication links such as infrared or radio links can be used. Further in the alternative, the user terminal can consist of an electronic organiser module/mobile radio telephone 25 combination unit, including a display and keyboard. Alternatively, the user station can be in effective mobile form by being constituted of a pci card plugged into a computer and serving as a radio modem. Similarly, a further alternative is a portable computer with a radio built in. Yet another alternative is a mobile telephone unit in which the user actions corresponding to those described earlier above are carried out by voice activation 30 and/or key stroke methods.

The present invention is applicable to numerous types of service provision in addition to the multi-media telephone call described above. For example, simple telephone calls, and facsimile, and so on, are included. In addition, the present invention also includes 35 services consisting of provision of information content. Examples of this are news

- bulletins, travel routes, tourist advice, and so on, that are provided for example via communication arrangements known as information highways, such as the internet. In the case when the service to be provided is such an information service, then when, say, the optimum cost was found to be from a combination of first network 120 and first
- 5 further communications element 150, then the information would be provided from service provider 140 to user terminal 110 along a communication route made up of communications link 142, first further communications element 150, communications link 122, first network 120, and radio link 112. This could be the case even if a direct communication link 126 between service provider 140 and first network 120 exists, on
- 10 the basis that link 126 was suitable or cost effective for the transmitting of resource functions according to the present invention, but not for the general provision of the service thereafter established.
- 15 It is to be appreciated that the embodiments above are merely exemplary, and other numbers of networks and further communications elements are included. Similarly, it is not necessarily the case that all networks involved will have access to all possible candidate further communications elements. Also, when only some of the required information is available, or when some of the information is incorrect, the resulting
- 20 resource functions, whilst imperfect, nevertheless provide a degree of benefit to the user such that his choice of network is still advantaged by the present invention.

Claims

1. A method of selecting a network in a cellular communications system; wherein a user selects a network from a plurality of networks in said communications system for provision of a service from a service provider to be provided to said user over a communications route which will comprise the selected network and a further communications element;
- 10 the method comprising the steps of:
 - 10 said user transmitting a resource query to said networks, said resource query identifying said service and said service provider;
 - 15 said networks communicating with said service provider to acquire service provider resource functions applicable to delivery of said service with respect to one or more candidate further communications elements;
 - 20 each said network determining a respective network resource function applicable to that network for delivery of services generally with respect to one or more candidate further communications elements;
 - 25 each said network calculating a respective overall resource function from said service provider resource functions and said respective network resource function;
 - 30 25 said networks transmitting their respective overall resource function to said user; and said user selecting whichever network has transmitted the optimum overall resource function.
 - 30 2. A method according to claim 1, wherein the resource to be considered is cost.
 3. A method according to claim 1, wherein the resource to be considered is power used by the user.

4. A method according to any preceding claim, wherein the user can vary which type of resource is to be considered.
5. An apparatus for selecting a network in a cellular communications system; wherein a user selects a network from a plurality of networks in said communications system for provision of a service from a service provider to be provided to said user over a communications route which will comprise the selected network and a further communications element;
- 10 the apparatus comprising:
 - means for said user transmitting a resource query to said networks, said resource query identifying said service and said service provider;
 - 15 means for said networks communicating with said service provider to acquire service provider resource functions applicable to delivery of said service with respect to one or more candidate further communications elements;
 - 20 means for each said network determining a respective network resource function applicable to that network for delivery of services generally with respect to one or more candidate further communications elements;
 - 25 means for each said network calculating a respective overall resource function from said service provider resource functions and said respective network resource function;
 - 30 means for said networks transmitting their respective overall resource function to said user; and
 - means for said user selecting whichever network has transmitted the optimum overall resource function.
6. An apparatus according to claim 5, wherein the resource to be considered is cost.
7. An apparatus according to claim 5, wherein the resource to be considered is power used by the user.

8. An apparatus according to any of claims 5-7, wherein the user can vary which type of resource is to be considered.

5 9. A network in a cellular communications system; wherein a user selects a network from a plurality of networks in said communications system for provision of a service from a service provider to be provided to said user over a communications route which will comprise the selected network and a further communications element;

10 the network comprising:

means for receiving a resource query from said user, said resource query identifying said service and said service provider;

15 means for communicating with said service provider to acquire service provider resource functions applicable to delivery of said service with respect to one or more candidate further communications elements;

20 means for determining a respective network resource function applicable to the network for delivery of services generally with respect to one or more candidate further communications elements;

25 means for calculating a respective overall resource function from said service provider resource functions and said respective network resource function; and

means for transmitting said respective overall resource function to said user.

10. A network according to claim 9, wherein the resource to be considered is cost.

30 11. A network according to claim 10, wherein the resource to be considered is power used by the user.

35 12. A network according to any of claims 9-11, wherein the network can respond to resource queries of different types of resource.

13. A user terminal for selecting a network in a cellular communications system; wherein a user selects a network from a plurality of networks in said communications system for provision of a service from a service provider to be provided to said user over a communications route which will comprise the selected network and a further communications element;

the user terminal comprising:

10 means for transmitting a resource query to said networks, said resource query identifying said service and said service provider;

means for receiving respective overall resource functions from said networks; and

15 means for selecting whichever network has transmitted the optimum overall resource function.

14. A user terminal according to claim 13, wherein the resource to be considered is cost.

20

15. A user terminal according to claim 13, wherein the resource to be considered is power used by the user.

16. A user terminal according to any of claims 13-15, wherein the user can vary which 25 type of resource is to be considered.

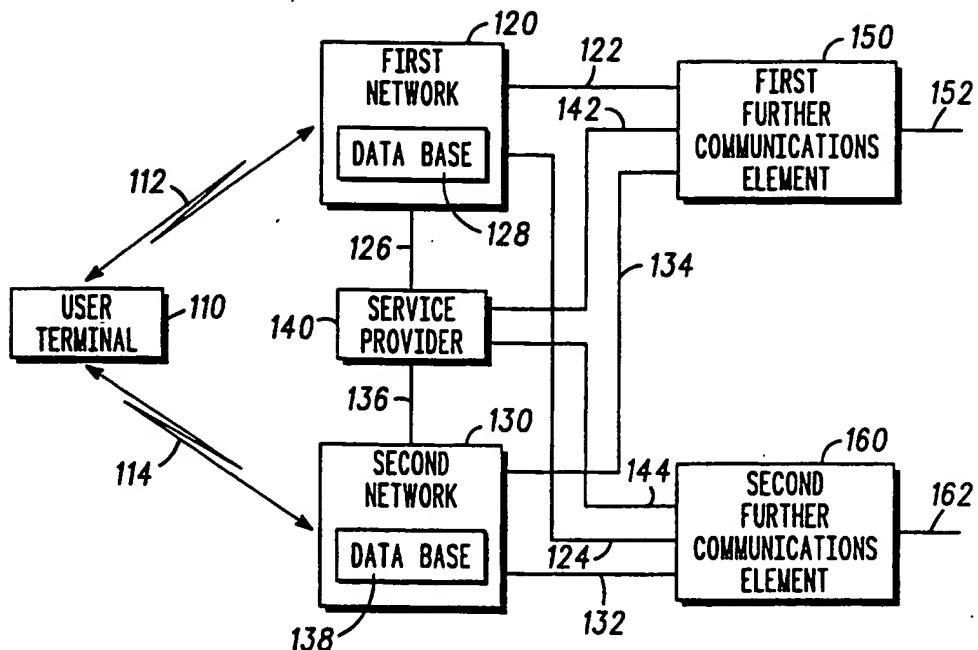


FIG. 1

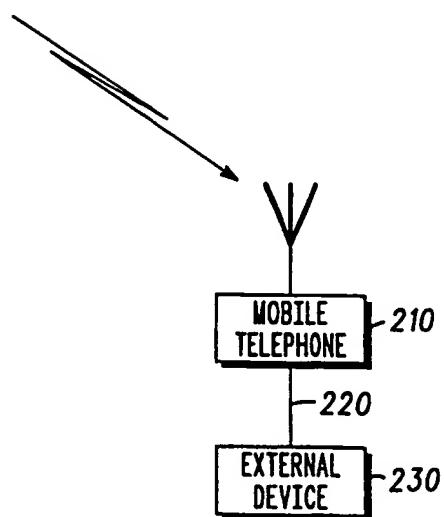


FIG. 2

INTERNATIONAL SEARCH REPORT

Inten. Appl. No
PCT/EP 00/00332

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 H04Q/38

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Patent family members are listed in annex.

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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PCT/EP 00/00332	

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